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CONTENTS

Plant diseases in British colonial dependencies: a half-yearly report, by S. P. Wiltshire 65

A new leafhopper-borne virus disease from the Netherlands, by Paul R. Miller 66

Aerial spraying for controlling spruce budworm in New Brunswick, Canada, 1953, by B. W. Flieger 68

Red spiders in western Europe, by the European Plant Protection Organisation 71

Diseases of economic crops in the Sudan. I. Cereals, by S. A. J. Tarr 75

Outbreaks and new records 78

British Somaliland
United States
Yugoslavia

News and notes 80

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FAO Plant Protection Bulletin

Vol. II, No. 5 A Publication of the February 1954

World Reporting Service on Plant Diseases and Pests

Plant Diseases in British Colonial Dependencies: a Half-Yearly Report

S. P. Wiltshire

Commonwealth Mycological Institute, Kew, England

Dominica

Wither tip of limes (*Gloeosporium limetticola* R. F. Clausen), which first appeared in the island in 1921, is still restricted to those ecological zones suited to the disease. Altitude is an especially significant factor affecting disease incidence. Small variations in the occurrence of the disease are attributed to weather conditions. The proper care and cultivation of the crop has been shown to contribute greatly to offset losses in yield due to the disease.

Red root disease of limes, sometimes associated with *Sphaerostilbe repens* Berk. & Br., has been successfully controlled by the gradual replacement of the seedling limes with budded material grown on highly resistant or immune stocks, no cases being recorded in recent years.

Leaf spot of bananas (*Mycosphaerella musicola* Leach) is present in all parts of the island, but is less severe near the coastal belt. In badly affected plantations even the fruit may be attacked and the plants killed, though this is rare. Control by spraying is under the direction of the Banana Leaf Spot Control Board. The Board is financed by a levy on the industry, and growers are supplied with free materials and equipment, the field staff of the Board supervising the control operations, comprising spraying and field sanitation measures.

Grenada

Root disease of nutmegs caused by *Rosellinia pepo* Pat. occurred during the period under review.

Witches' broom disease of cacao (*Marasmius perniciosus* Stahel) is reported by the Plant Disease Inspectorate to show an over-all reduction in incidence.

Mauritius

The Director of Agriculture reports that a disease of sugar cane, attributed to an undetermined species of *Sclerospora*, probably *S. macrospora* Sacc. or close to this species, has been found on one estate in the center of the island. The disease is believed to have existed on the island for some time, but was taken to be the result from a proliferation of the node galls on the underground parts of the cane stool. It is considered to be of minor importance.

A New Leafhopper-Borne Virus Disease from the Netherlands

PAUL R. MILLER

Bureau of Plant Industry, Soils, and Agricultural Engineering,
United States Department of Agriculture

IN connection with his investigations carried out under the joint auspices of the Laboratories of the Rockefeller Foundation for Medical Research, New York, and the Institute for Phytopathological Research, Wageningen, Karl Maramorosch reports the discovery in Holland of a new leafhopper-borne virus capable of infecting crimson clover (*Trifolium incarnatum*). He points out that our present knowledge of plant viruses transmitted by leafhoppers is based mainly on viruses that attack cultivated plants. He considers that a source of unrecorded plant viruses may be provided by the numerous leafhopper species that are symptomless vectors and can often support the multiplication of viruses they transmit. The perpetuation of such virus within the insect population for many generations may result in their widespread dissemination. An intensive study of viruses harbored by leafhoppers, therefore, may yield much basic information on this subject.

Until recently Western Europe was the only part of the world in which no leafhopper-transmitted plant viruses had been reported. From symptomatology and general evidence it seemed likely that at least four diseases there might be leafhopper-borne. These diseases are: a disease of cherry trees known as "Eckelrade disease" in Holland and as "Pfeffinger disease" in Switzerland, hop nettlehead and potato witch's broom in England, and raspberry (*Rubus*) stunt in

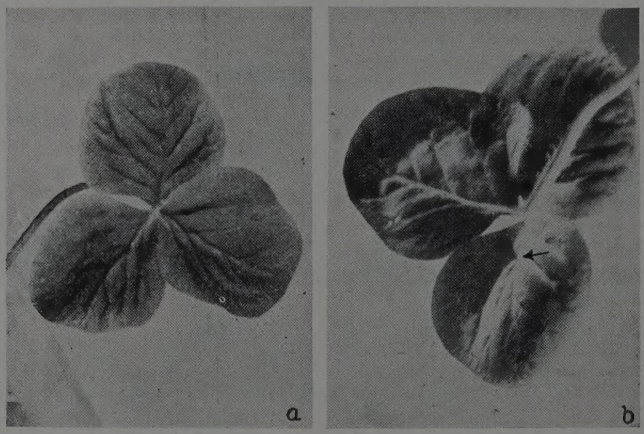

Fig. 1. *Symptoms on crimson clover (Trifolium incarnatum) caused by an unrecorded leafhopper-borne virus. (a) Upper surface of a clover leaflet showing deep ridges due to enlarged veins. (b) Same leaflet from below, arrow indicating a pronounced enation. Both x 1 ½.*

several European countries. It is reported that evidence that raspberry stunt is actually transmitted by the leafhopper *Macropsis fuscula* (Zett.) has recently been obtained in Holland.

During the summer of 1953 cherry orchards were visited near Maastricht in the southern part of the Netherlands, in the region where severe outbreaks of Eckelrade

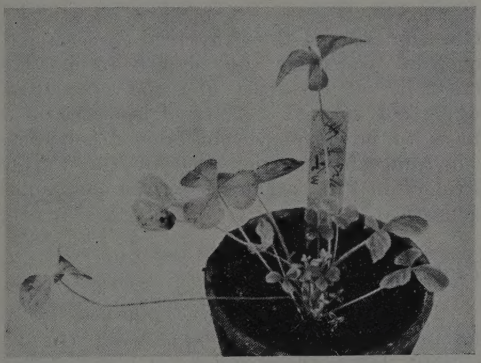

Fig. 2. *Advanced stage of the disease, showing younger small chlorotic leaves on short petioles.*

disease were reported in previous years. From observations by several workers it was known that spread of the disease was irregular and that a number of trees had escaped infection, although these healthy trees grew in close proximity to cherry trees with the disease. Since earlier tests of leafhopper species found on cherry trees had failed to reveal a vector, it seemed possible that a species not normally found on trees but able to feed on them in the absence of its proper food plant might be responsible for transmission. This hypothesis led to the collection of various species of Cicadellid leafhoppers in the grass. Fairly large numbers of *Euscelis plebejus* ssp. *plebejus* (Fall.) were obtained by sweeping with a net under the trees. The insects were tested in a greenhouse in Wageningen on a variety of host plants. Only 2 out of 15 of the leafhoppers survived more than two days on cherry seedlings and these eventually died on the tenth day. The seedlings remained in a greenhouse for further observation.

On crimson clover plants the insects lived and deposited eggs from which nymphs hatched within two weeks. As a result of these greenhouse tests, a new virus disease of crimson clover was detected. After a minimal incubation period of five days at 65° F., 5 out of 16 clover plants on which 16 individual leafhoppers were caged showed disease symptoms. From a second collection, 3 out of 10 insects induced the same symptoms. First disease signs were characterized by enlarged veins (Fig. 1 *a*) and deep ridges on the upper surfaces of leaflets. The vein symptoms were somewhat reminiscent of the wound tumor disease. Pronounced enations were noted on the lower surfaces of leaflets (Fig. 1 *b*). Later symptoms were chlorosis, which progressed from the outer edges towards the mid-ribs of leaflets, and small malformed leaves on shortened petioles (Fig. 2).

The preliminary experiments have shown that *E. plebejus* harbored a virus which caused a previously unknown clover disease. A search in the orchard where the leafhoppers were collected failed to reveal diseased clover plants. It is hoped that further work will give more information on the virus–host relationship and on the host range of the virus and its possible connection with the causative agent of the Eckelrade disease.

Aerial Spraying for Controlling Spruce Budworm in New Brunswick, Canada, 1953

B. W. FLIEGER
Forest Protection Ltd., Campbellton, New Brunswick, Canada

THE spruce budworm, *Choristoneura fumiferana* (Clem.) has long been considered the most destructive forest insect in Canada. Since 1910, about 300,000,000 cords of spruce and balsam pulpwood have been killed in eastern Canada, mostly in Ontario and Quebec. Within the last six years, the budworm population has steadily increased in northern New Brunswick. Aerial surveys showed that about 4,000 square miles of balsam spruce forest in that area had suffered severe defoliation of new shoots in 1952, compared with 2,200 square miles in 1951.

In 1952, an aerial spraying project was undertaken jointly by the Government of the Province of New Brunswick and the Canadian International Paper Company to protect the very valuable stand of balsam fir until those who hold the right to extract timber were in a position to harvest it. Approximately 300 square miles of forest on the south-east Upsalquitch watershed in New Brunswick were sprayed during June. Technical assistance was provided by the Division of Forest Biology, Science Service, Canada Department of Agriculture, consisting of assessing the amount of spray deposit, correct timing of operations, and analyzing the results.

Since experience gained in 1952 appeared to indicate that large scale aerial spraying operations were the only possible means of saving budworm-infested forests from destruction, representatives of the Dominion Government, the Provincial Government of New Brunswick and four major pulp companies operating in northern New Brunswick met in August 1952 to discuss the continuation of the spraying project in ensuing years. A tentative plan was adopted for the spraying of 4,000 to 5,000 square miles of infested forests over a period of three years at an estimated cost of $ 9,000,000. The Dominion Government and the Provincial Government of New Brunswick each agreed to provide one-third of this cost and the companies undertook to bear a share of the cost on a basis to be developed in later discussions. The program was managed by the Forest Protection Ltd., organized by the companies concerned.

Field Organization

The 1953 program was planned for a minimum of 1,000,000 acres and was patterned closely after the project of 1952. Five airfields were constructed between September and December 1952 which, with "Budworm City," provided six bases for operations in the spring of 1953.

The formulation used in 1953 consisted of technical DDT dissolved in oil (Picco Hi-Solv No. 473)– one pound to one U.S. gallon (1 gallon = 3.7853 liters) or approximately at 12 ½ percent solution by weight. In all, 1,100,000 gallons were purchased. The formulator delivered the insecticide to railhead over a four-month period, December to March, supplying 60 percent in drums and the remainder in bulk. All but a small part was delivered to the airfields by truck or tank truck before the spring break-up. Approximately 175,000 gallons were moved to destination during the spraying operation. At three fields insecticide was stored entirely in 10,000-gallon tanks. At the three more remote fields, tank storage for one day's operations was provided and transfer from drums to storage was made during spraying operations. Both systems worked well.

The application of insecticide was carried out under contract by a Canadian prime contractor operating seven aircraft, with three Canadian sub-contractors operating

eleven aircraft and two United States subcontractors operating 59 aircraft. All 77 line aircraft were Stearmans, equipped with Pratt and Whitney Junior engines of 450 h.p.

In order to control flying operations, Forest Protection Ltd. engaged seven chief pilots, purchased one observation plane (Stinson 108) and leased eight others.

During the winter months, accommodation to house personnel was built, extensive aircraft servicing facilities were purchased, delivered to the fields and installed as soon as the snow disappeared. A detailed breakdown of the forest into spraying blocks was carried out and the necessary maps and aerial photographs were provided in advance of the spraying operation.

Spraying Plan

The spraying fleet began to arrive at New Brunswick spraying airfields about 20 May. Calibration of aircraft was carried out within a week, and all aircraft were checked and ready for spraying by 27 May. Spraying, in fact, began on 26 May and was completed on 30 June. In 1952, spraying began on 14 June and terminated on 29 June. In both years, the work was completed by the beginning of pupation of the insect.

It was decided to try to extend the insecticide on the basis of experience gained in 1952. During calibration, tests were run for swath width in which two aircraft, flying at controlled separation distances, were considered as a spraying unit. The emission rate was the same for all aircraft and was that used in 1952 when, for the first half of the program, aircraft flew singly, employing a theoretical swath width of 100 feet and a theoretical dosage of one gallon per acre. The results of the 1953 tests indicated that in fairly still air the aircraft could be separated 250 feet with the certainty that their swaths would overlap. They also indicated that the effective swath outside the planes for the purpose of matching consecutive runs was of the order of 75 feet per aircraft, giving an effective swath width for the unit of 400 feet and a theoretical dosage of one-half gallon per acre. These results were supported by field tests of an operational nature under ordinary spraying weather conditions. The area missed was shown to be very small and less than with single aircraft the year before. All spraying operations in 1953 were carried out by aircraft flying in pairs, trying to maintain a separation distance of 250 feet between planes. As the spraying plan had been developed with this change in technique in mind, much more than the minimum target of 1,000,000 acres had been delineated on maps and photographs. The test was the first of its kind and seems to have great significance. An outstanding advantage of this flying technique, beyond that of safety, is the rapidity with which forest areas can be covered. This allows the sprayer to buy time when time is very precious, even to the point where a second application can be carried out on the same area in the same season. From one airfield, two applications were given over an area of almost 250,000 acres.

The spraying plan called for an early start, as soon as the new foliage had flared enough to intercept the spray and the insect was at a stage of development where the insecticide could effect a kill. The plan, as prepared, was conservative provided ordinary weather was experienced during the development of the budworm larvae.

Safety Measures

Care was taken in advance to make the operation as safe as possible. At all fields, extreme precautions were taken against the occurrence of fire, both in the camps and on the fields. First aid men were present at each field and a doctor was employed full time during operations. All possible precautions were taken to ensure safe flying. Each field had its own traffic pattern and a close check was kept on the performance of all aircraft. Fifteen mechanics were necessary to keep the fleet flying. The Stearman aircraft is established as a reliable and comparatively safe forest spray plane, and the practice of flying in pairs cuts down the necessity for search in the event of accident. As a further precaution, a helicopter stood by at the Chatham R.C.A.F. base during the spraying operations in the event that rescue operations were necessary.

It was extremely satisfactory that this large-scale operation was carried out without

loss of life. Considering the number of persons involved and the amount of flying, accidents involving aircraft were singularly few. There were six incidents: four accidents, two aircraft washed out, but no pilots hurt.

No large forest spraying program could be launched without a reliable communications system. The New Brunswick Forest Service provided an extensive radio hook-up, linking together ten fire towers, six airfields, eight observation aircraft, one motor vehicle and the main control office. The fire towers were occupied by weather observers and a very close check was kept on the weather at all times.

Assessment of Results

The Forest Biology Division, Science Service, was a full partner in all the advance planning and co-operated fully during the spraying period. Staff of the Laboratory of Forest Biology at Fredericton handled the biological checking of results and conducted their own program of study during and after the spraying period.

Plans are made to be changed and the 1953 spraying plan was no exception. It is difficult to anticipate the vagaries of the weather. After the time had arrived when spraying could be undertaken with some degree of success, every advantage was taken of spraying weather; areas that had been sprayed first were watched closely by entomologists who advised whether further applications of insecticide were necessary. As the days went by and primary areas were completed and it appeared in some cases that the one application might produce a good result, spraying was carried over into secondary areas. Almost 1,100,000 gallons of insecticide were sprayed over approximately 1,800,000 acres of forest, almost one-quarter of which received a second application.

This year, an attempt was made to save as much of the current year's foliage as possible before the insect had a chance to destroy it completely and the entire effort was designed to remove budworm feeding pressure from the forest. The results of the spraying have been studied since the beginning of July and will shortly be available.

The technique developed from the 1953 project resulted in a great reduction in the cost of a single application and marks important progress in working out a fast, cheap method which will allow large forest areas to be covered more than once when necessary during a campaign to keep trees alive through a budworm epidemic.

Red Spiders in Western Europe

EUROPEAN PLANT PROTECTION ORGANISATION
Paris

THIS survey is mainly based on replies to an enquiry made by the European Plant Protection Organisation in June 1953 at the request of the Federal Republic of Germany, which was concerned about the growing importance, economic and otherwise, of certain red spiders such as *Metatetranychus ulmi*. In addition, some monographs and other publications have been consulted. Information received from Israel is also included here for convenience.

It is still very difficult to give anything like a comprehensive survey of experiences in different countries with the family Tetranychidae which has only recently become of widespread interest. Different views occur particularly in the field of nomenclature, where acarologists and applied entomologists have not yet reached agreement. Synonyms of some species, e. g. *Metatetranychus ulmi* = *Paratetranychus pilosus*, are not accepted in all countries. Species, e. g. *Eotetranychus telarius*, which are considered by some specialists to be specific to a limited number of host plants, are described by others as polyphagous and ubiquitous.

Opinions on control measures are also conflicting. New insecticides and specific acaricides are being tried in many places. The results are very encouraging but have not yet proved conclusive.

Species of Major Importance

Four species have been found to occur most commonly in Europe. Their nomenclature as adopted in this report, as well as their biological characteristics, are as follows:

1. *Metatetr nychus ulmi* Koch

Synonyms: *Tetranychus ulmi* Koch; *T. pilosus* C. & F.; *T. mytilaspidis* Ewing; *Paratetranychus pilosus* Zacher; *Oligonychus ulmi* Hirst; *O. alni* Oudem.; *Metatetranychus alni* Oudem.

Common names: Fruit tree red spider, European red spider, araignée rouge du pommier, Obstbaumspinnmilbe, fruitspint.

Host plants: Mainly apple, also pear, plum, cherry, *Ribes sanguineum*, raspberry, rose, grapevine, *Sorbus*, *Rhamnus frangula*, elm, alder, chestnut.

Hibernation stage: Egg.

2. *Tetranychus urticae* Koch

Synonyms: *Tetranychus althaeae* von Hanst.; *T. urticae* Oudem.: ? *T. bimaculatus* Harvey.

Common names: Hop red spider, common red spider, araignée rouge, araignée jaune, Bohnenspinnmilbe, bonenspint.

Host plants: Polyphagous on herbaceous plants, including runner bean, soybean, clover, violets, carnation, rose, raspberry, dahlia, cotton, hop, grapevine, potato, tomato, eggplant, cucumber, gherkin, and common on glasshouse plants. Also attacks fruit trees and citrus. (Fruit trees infested by this species seem to be avoided by *Metatetranychus ulmi*.)

Hibernation stage: Adult female.

3. *Eotetranychus telarius* L.

Synonym: *Tetranychus tiliarum* Koch.

Host plants: Chiefly lime tree, also horse chestnut, maples (especially *Acer negundo*), plane tree and hawthorn. Recently found on apple. Not on herbaceous plants, nor in glasshouses.

Hibernation stage: Adult female.

4. *Bryobia praetiosa* Koch

Synonyms: *Bryobia speciosa* Koch; *B. nobilis* Koch; *B. ribis* Thomas; *B. pratensis* Garm.

Common names: Gooseberry red spider, ivy red spider, clover mite, bryobe précieux, rote Stachelbeermilbe, kruisbessenspint.

Host plants: Gooseberry, fruit trees, citrus, violets, grasses, *Ribes*, ivy, and possibly others.

Hibernation stage: Egg.

Changes in Incidence

Metatetranychus ulmi. This species was found to be increasing in Norway, Denmark, England (south and south-east), the Netherlands, Germany (especially the north), Austria, Italy, France and probably in some local pockets in Portugal. In Switzerland and Belgium heavy infestations, not considered to be abnormal, occurred. Usually the increase has been noted during the last four to seven years, with abnormal outbreaks in certain years, such as in France in 1952, but in some cases it was observed much earlier, e. g., Denmark in 1925, and England in 1933.

Tetranychus urticae. This red spider is numerous in practically all countries, but, in general, its incidence has not greatly changed. Its occurrence is mentioned by Israel, Norway, England, Germany, Austria, Switzerland, and France, where the species is even listed as the main pest of the Mediterranean zone. Attacks on citrus trees occurred in Israel, where they did not increase after continuous use of DDT against other pests, and probably also in Italy. In England,[1] this pest has appeared in gradually increasing numbers in apple orchards in Essex since 1949.

It is noted that this species is rather vulnerable in its hibernating stage. In consequence, its numbers may differ greatly from year to year. In Switzerland, the populations were greatly reduced during the winter 1952/53 by severe weather conditions.

Eotetranychus telarius. Taxonomic discrepancies occur particularly with regard to this species. Several specialists call attention to the confusion which has arisen from differences in nomenclature, and any compilation of the conflicting data now available might prove misleading. Nevertheless it is justifiable to stress that this species, which is regarded by some specialists as restricted to lime (*Tilia*) and some other ornamental trees, was found on apple in Germany.

Bryobia praetiosa. This is another species which shows increase, e.g., in Austria, the Netherlands and Norway. In other countries it is locally abundant but there have been no abnormal outbreaks, even where it has up to eight summer generations, as in Switzerland. In France it was found on citrus. In Israel, the species does not occur.

This species almost certainly consists of different biological races which cannot be separated morphologically. In the Netherlands, it was found to have one generation on gooseberry, but up to three on apple. Invasions of human dwellings always originate from nearby lawns and should be attributed to a " grass-race. "

Possible Causes of the Increased Incidence

The increase of red spider populations in Europe seems to be an established fact. In *Tetranychus urticae* it was apparently more intensive in countries bordering the Mediterranean, but otherwise it has been general as in *Metatetranychus ulmi* which became a serious pest practically all over Europe, without marked differences between northern and southern regions. Consequently many countries have given consideration to the underlying causes of these variations. The fact that the increases started in different periods indicates the complexity of these causes.

(*a*) *Climatic factors.* Hot and dry weather is known to favor the development of red spiders, hence the sudden flaring up in late summer, even in temperate countries. This phenomenon has been responsible in particular for certain seasonal outbreaks, such as in France in 1952, but it probably also had a more lasting effect as in recent years spells of dry weather have occurred in many European countries, e. g. Italy and Portugal. However, such increased incidence can be counteracted by periods of high humidity and rain. It seems, therefore, that climatic changes cause fluctuations which in general more or less offset each other.

(*b*) *Use of pesticides.* Far greater importance is attributed to the ever-increasing use of powerful insecticides and fungicides. Belgium, Denmark, England, France, Norway Portugal, and especially Switzerland, refer to their influence. These chemicals can interfere in different ways. Some have a

[1] COLLYER, ELSIE. The greenhouse red spider mite, *Tetranychus urticae* Koch, on apples in East Anglia. *Ann. Rep. E. Malling Res. Sta. for 1952.* pp. 159-160. 1953.

direct physiological action causing a higher reproductive rate in red spiders as has been ascertained for DDT by Hueck *et al* [2] and is also supposed for BHC and aldrin. The most serious factor, however, is that the newer chemicals are often non-selective and also kill the natural enemies of the pest to be controlled. Such beneficial predators (e. g., the bug *Malacocoris chlorizans* Panz. and mites of the genus *Typhlodromus* in Switzerland, Anthocorid mites in Denmark, and many other species) always build up their populations slowly after chemical treatments. Meanwhile the red spiders, which have escaped or hatch after the treatment, multiply unchecked, by means of their high fertility.

The situation grew gradually worse when winter washes, such as tar or mineral oils and DNC, came into general use. There is little doubt that through reducing the number of predators these washes were responsible for building up mite populations over a number of years. Certainly summer treatments contributed to upset the natural equilibrium still further. DDT and BHC must have killed many predators, though sometimes the spraying programs were adjusted to minimize this risk. Parathion is considered to be particularly disastrous in this respect. [3] Fungicides also play a rôle, wettable sulphur probably being worse than lime sulphur, and organic compounds, such as thiocarbamates, being worst of all.

Mathys [4] summarizes the situation in Switzerland by stating that no outbreak of red spiders has ever been found in any neglected orchard where no insecticides or fungicides have been used. Consequently the Swiss Advisory Service recommends restricting chemical treatments to one spring application at petal fall. During summer high pressure spraying with clear water should first be tried and a specific acaricide should be used only if strictly necessary.

The newer acaricides can certainly improve direct control of red spiders. However, the stimulation of small mite populations in places where other pests are controlled by means of contact poisons will remain an important factor.

(*c*) *Other factors.* The fact that in neglected orchards red spider attacks are less destructive than in well kept ones has also been ascertained in other countries, e. g., the Netherlands, where other causes have been considered. Kuenen [5] points out that not only do the two types of orchards differ with regard to the application of pesticides, but to intensity of manuring, method of pruning, etc., and that the physiological condition of these trees in well kept gardens was far better. On these healthy trees, which presumably provided better food, the egg production of *Metatetranychus ulmi* was 2½ times greater than in neglected orchards. This difference may partly or wholly explain why heavy outbreaks are found particularly on well kept trees.

Control Measures

Chemical control of red spiders may be complicated. In winter some widely used sprays, such as tar oils and DNC (dinitro-o-cresol, even at 200 grams active ingredient per hectoliter), do not sufficiently penetrate mite eggs, whereas the hibernating adult females of certain species are even more difficult to kill. In summer, eggs, larvae and adults are found together. Most chemicals, however, are effective against either eggs or other stages. Therefore, treatments must usually be repeated after about 10 days when remaining individuals have reached a vulnerable stage. Careful observation of development and correct timing of treatments are crucial in red spider control, and often when these requirements are not ful-

[2] HUECK, H. J., D. J. KUENEN, P. J. DEN BOER and E. JAEGER-DRAAFSEL. The increase of egg production of the fruit tree red spider mite (*Metatetranychus ulmi* Koch) under influence of DDT. *Physiol. Comparata et Oecol.* 2: 371–377. 1952.

[3] COLLYER, ELSIE. The effect of spraying materials on some predatory insects. *Ann. Rep. E. Malling Res. Sta. for 1952.* pp. 141–145. 1953.

[4] MATHYS, G. La protection contre les acariens nuisibles au feuillage des arbres fruitiers. *Rev. Romande d'Agr. de Viticult. et d'Arboricult.* 9 : 49–51. 1953.

[5] KUENEN, D. J. The fruit tree red spider (*Metatetranychus ulmi* Koch, Tetranychidae, Acari) and its relation to its host plants. *Tijdsch. Ent.* 91 : 83–102. 1949.

filled the chemicals are blamed for unsatisfactory results.

The available data show that European countries, though sometimes applying tar oil as a winter wash, mostly prefer mineral oils and DNC. In Portugal, thiocyanates (3 to 5 percent) are sometimes added. In summer the most widely used pesticide is parathion, which in general gives good control, especially when used in summer oils. However, Denmark, France and Italy report unsatisfactory results. It is considered that resistant races may have developed. Other pesticides used are sulphur (as spray or dust), lime sulphur, TEPP (tetraethyl pyrophosphate) and nicotine sulphate. In many countries very good results were obtained with systemics such as Systox (ethyl mercaptoethyl diethyl thiophosphate) and Schradan (octamethyl pyrophosphoramide), but their use was restricted to where possible risks to consumers could be avoided.

Glasshouse growers now chiefly rely on parathion or azobenzene in sprays, aerosols or smokes. In England, where some populations of the mites appeared to have developed resistance to azobenzene, Sulfatep (tetraethyl dithiopyrophosphate) was applied successfully.

A great number of new specific acaricides or ovicides was introduced in recent years. In several European countries some are already used on a wide scale, whereas in others they are still in the experimental stage. For the convenience of plant protection services a summary of experiences in different countries is given below. It must be understood, however, that this summary is not claimed to be complete. In some countries experimental data possibly could not be made available before the chemical concerned had been officially approved.

PCPBS (p–chlorophenyl benzene sulphonate). Practice in England, the Netherlands and Norway; experiments in Portugal.

PCPCBS (Ovotran; K 6451; p–chlorophenyl p–chloro–benzene sulphonate). Experiments in Italy.

Chlorobenzilate (Geigy 338; 4, 4, dichloro benzilic acid ethyl ester). Practice in Switzerland; experiments in France.

Chlorocide (p–chlorobenzyl p–chlorophenyl sulphide). Practice in England; experiments in the Netherlands.

DPS (Sulphenone; p–chlorophenyl phenylsulphone). Practice in England; experiments in Italy.

Diazinon (Geigy 24480; 0,0–diethyl–0(2–isopropyl–4–methyl–pyrimidyl thiophosphate). Experiments in France.

EPN (ethyl p–nitrophenyl thionobenzene phosphonate). Practice in the Netherlands.

Aramite (88R; 2–(p–tert–butylphenoxy) isopropyl 2–chloroethyl sulphite). Practice in Sweden; experiments in Italy, Portugal, and the Netherlands.

DMC (Dimite, 4,4–dichloro–alpha–methylbenzhydrol). Practice in Norway.

Malathon (0,0–dimethyl dithiophosphate of diethyl mercaptosuccinate). Practice in the Netherlands; experiments in Italy.

Other Records

France. Amphitetranychus viennensis Zacher was found on apple, pear and peach trees. No species other than *Bryobia praetiosa* was recorded attacking citrus trees.

Germany. Other red spiders found were: *Amphitetranychus viennensis* Zacher (= *A. crataegi* Hirst) and *Tenuipalpus oudemansi* Geijskes, both on apple. In glasshouses *Brevipalpus orchidarum* Oudem. attacked orchids.

Israel. Local red spiders, specific to citrus, are *Anychus orientalis* Zacher and *Brevipalpus australis* Tuck. These species and *Tetranychus urticae* were efficiently controlled with sulphur. On deciduous fruit trees and grapevine another *Brevipalpus* sp. is found in small numbers.

Italy. Apple, nut and fig trees and even more peach and citrus trees were heavily attacked by red spiders. Identification of the species concerned is in progress.

Portugal. In certain regions serious infestation of fig trees by *Tetranychus* sp. was observed. Citrus groves were not infested as they were treated regularly with summer oils against coccids.

Conclusion

It is hoped that this report, which is necessarily preliminary in character, may serve to initiate an active interchange of practical information on red spider mites. Plant protection services are invited to give their comments and amendments and to submit to the European Plant Protection Organisation additional data on incidence and control measures, etc.

Diseases of Economic Crops in the Sudan
I. Cereals

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THESE notes present a brief summary of the diseases which attack economic crops in the Sudan. Climate and vegetation within this country are very diverse and range from rainless desert areas in the extreme north, through regions in which rainfall is usually sufficient for quick maturing crops, to the wet southern areas where annual rainfall reaches some sixty inches. The Sudan is largely flat with few natural obstacles to the spread of plant diseases. Certain crops such as sorghum and maize are cultivated throughout the country, as irrigated crops in the dry north and under rain in the centre and south. The distribution and incidence of fungi and plant diseases under such diverse climatic conditions constitute a highly interesting field of study, the salient points of which have been considered elsewhere[1]. Crop diseases in the agriculturally developed areas of the northern Sudan are moderately well listed but comparatively little is known concerning those in more remote regions where agricultural development is in its early stages. In such areas new and important diseases may be expected to appear as development proceeds. In recent years seeds of numerous crop varieties have been imported into the Sudan for trial and, despite quarantine, some seed-borne pathogens may have been introduced. These considerations emphasize the great importance of up-to-date and thorough listing of crop diseases.

Sorghum (*Sorghum vulgare*)

This is by far the most important cereal of the Sudan, several million acres being grown annually as rainfed or irrigated crops in all parts of the country. It is the staple food and also provides forage for stock and stalks for building. Covered smut (*Sphacelotheca sorghi*) occurs wherever the crop is grown and can cause heavy losses. These are preventable by use of fungicidal seed dressings, a method of disease control which is effective, simple, safe and inexpensive. Seed treatment with 25 percent thiram (TMTD) powder at the rate of 1 gram per pound of seed is encouraged by all possible means. Even so it is rarely carried out in some areas and there covered smut can be responsible for avoidable grain losses running into many thousands of tons annually. Recent research has shown that seed treatment with a combined fungicidal/insecticidal powder containing 20 percent gamma benzene hexachloride (BHC) effectively protects sorghum seedlings from root attack by cockchafer grubs, *Schizonycha* sp., in the Gezira areas. Further south in the central rainlands area such seed dressings are reported to discourage the depredations of the ant *Pheidole rugaticeps*, which often consumes or carries away sown seed.

Loose smut (*Sphacelotheca cruenta*), head smut (*S. reiliana*) and long smut (*Tolyposporium ehrenbergii*) infect sorghum in most parts of the Sudan. Although occasionally severe locally they rarely cause economic losses. Leaf diseases including unidentified bacterial blights, leaf blight (*Helminthosporium turcicum*), sooty stripe (*Ramulispora sorghi*) and gray leaf spot (*Cercospora sorghi*) are very common and occasionally severe on sorghum in the wetter central and southern Sudan. Rust (*Puccinia purpurea*) is widespread in the same areas and also in the humid Red Sea coastal plain where it is sometimes markedly destructive. Minor leaf diseases include zonate leaf spot (*Gloeocercospora sorghi*), rough leaf spot (*Ascochyta sorghina*) and leaf spotting caused by *Phyllosticta sorghina* (= *Phoma insidiosa*). Anthracnose (*Colletotrichum graminicola*) is very prevalent in areas of more than about fifteen inches annual

[1] TARR, S.A.J. The fungi and plant diseases of the Sudan. Commonwealth Mycological Institute, Kew, England. (In press).

rainfall and often appreciably checks the growth of young plants; the more destructive stalk rot of this disease, such as occurs in the United States, has not been reported.

It is surprising that no specific or serious root or stalk rot of sorghum has been found in the Sudan. In particular the absence of charcoal rot, *Macrophomina phaseoli*, of sorghum is noteworthy since this pathogen attacks certain other crops in most parts of the country. Head moulds associated with *Curvularia*, *Cladosporium* and other fungi are sometimes widespread in seasons of late rains in the wettest areas.

Pearl Millet (*Pennisetum typhoides*)

More than half a million acres of pearl millet or bulrush are cultivated annually on lighter soils in the central and southern Sudan and on the Red Sea littoral. Grain smut (*Tolyposporium penicillariae*) occurs commonly south of the Gezira but normally causes negligible losses since only a small number of grains in each head are affected. Downy mildew and green ear, both caused by *Sclerospora sorghi*, and rust, *Puccinia penniseti*, frequently attack this millet in areas of more than about fifteen inches annual rainfall and on the humid Red Sea coast. Severely rusted plants are not uncommon and the disease is undoubtedly responsible for appreciable grain losses in some areas and seasons. Green ear can also be very destructive in localised patches where climatic and soil conditions favour its incidence but it is of little overall significance. It reaches its maximum in the wetter parts of the central Sudan and has not been observed in the extreme south where rainfall is heavier and temperatures somewhat lower. Plants attacked by green ear rarely produce much grain. Minor leaf diseases, e.g. leaf spot caused by *Piricularia grisea*, occur but no root or stalk roots have been observed.

Maize (*Zea mays*)

Maize is grown in all parts of the Sudan to the extent of some fifty thousand acres annually. Leaf streak symptoms, probably caused by maize streak virus, are often found in the southern Sudan and severe infections sometimes develop. *Helminthosporium turcicum* often causes destructive leaf blighting in the central and other parts of the Sudan. Leaf spotting caused by *Cochliobolus heterostrophus* (= *Helminthosporium maydis*) and rust, *Puccinia sorghi*, occur in the wetter areas but are of little economic importance. A year ago a very destructive rust attack on maize was observed at Roseires not far from the Sudan/Abyssinia border. Although only uredospores have been found the rust concerned is almost certainly *Puccinia polysora*. It is likely that this pathogen arrived in the Sudan during comparatively recent times since crop diseases in the Roseires area were surveyed during 1939–1945 and the destructive effects of the disease, if present, would hardly have passed unnoticed. *P. polysora* was originally found in the New World and has lately appeared in various African countries. Its destructive nature makes it imperative that its future spread in the Sudan be watched carefully. Such notable maize diseases as bacterial wilt (*Xanthomonas stewarti*), brown spot disease (*Physoderma maydis*), the root, stalk, seedling and ear diseases caused by *Diplodia macrospora* and *Gibberella* spp. and head smut (*Sphacelotheca reiliana*) are not known on maize in the Sudan, although head smut is wide spread on sorghum. Maize smut (*Ustilago maydis*) is rarely seen.

Finger Millet (*Eleusine coracana*)

This is a major cereal crop of the wetter parts of the southern Sudan. It appears to be remarkably free from diseases and only leaf spotting (*Helminthosporium nodulosum*) and black leaf spot (*Phyllachora eleusines*) have so far been recorded, neither of which is of much economic importance.

Wheat (*Triticum aestivum*)

Up to about 50,000 acres of wheat are grown annually in the Sudan, almost entirely as an irrigated winter crop in the north. Black rust (*Puccinia graminis*) can be very destructive in warm humid seasons when its extremely rapid spread not uncommonly reduces grain yield by 50 percent or more. In drier seasons the disease is less serious. The Hindi variety cultivated in parts of the northern Sudan shows some resistance.

Barberry, the aecidial host of *P. graminis*, does not grow in the Sudan and the uredospores of this rust are relatively short-lived; the method by which the pathogen persists between wheat crops is not understood. Possibly annual re-infection by wind-borne uredospores from distant sources outside the Sudan occurs, as in India. Brown rust (*Puccinia triticina*), powdery mildew (*Erysiphe graminis*) and loose smut (*Ustilago tritici*) all occur on wheat in the northern Sudan but are rarely more than minor diseases. Eye spot (*Cercosporella herpotrichoides*), take-all (*Ophiobolus graminis*), bunt (*Tilletia caries*) and yellow rust (*Puccinia glumarum*) have not been observed, although yellow rust may well be present since it occurs in Egypt, Kenya, Uganda and Eritrea.

Barley (*Hordeum vulgare*)

Irrigated winter barley is cultivated on a small scale in the northern Sudan. Although sometimes attacked by powdery mildew (*Erysiphe graminis*) and black rust (*Puccinia graminis*) the commonest disease is loose smut (*Ustilago nuda*), which occasionally causes appreciable grain losses.

Rice (*Oryza sativa*)

Small areas of this crop are grown in parts of the Sudan and the possibility of large scale development are being investigated. Among rice diseases which have already appeared are brown leaf spot (*Helminthosporium oryzae*, conidial stage of *Ophiobolus miyabeanus*) which is sometimes severe, leaf spot (*Cercospora oryzae*) which at present appears to be relatively rare, and black mould (*Cladosporium herbarum*) commonly present on grains which have not filled out properly. Blast (*Piricularia oryzae*), although not as yet recorded in the Sudan, may well appear in the near future since it occurs in Kenya, Uganda, Tanganyika and West Africa.

Outbreaks and New Records

British Somaliland

W. J. HALL
Commonwealth Institute of Entomology, London

First Record of Diocalandra frumenti on Date Palms in Continental Africa

At the end of January 1954 some specimens of beetles collected on date palms were received for identification from V. H. W. Dowson, Date Scheme, Berbera, Somaliland Protectorate. These have been identified as *Diocalandra frumenti* F. by Sir Guy Marshall, who remarks:

> This species is widely distributed in the Oriental tropics, being especially attached to coconuts, on which it is generally regarded as a rather minor secondary pest; though in a few cases more serious damage has been reported. We have no record of its occurrence on date palms, nor has it ever been reported previously from continental Africa, though it is abundant in the islands of the Indian Ocean.

Further information is being sought on the occurrence and importance of this pest on date palms in Africa.

United States

Plant Pest Control Branch,
Agricultural Research Service,
United States Department of Agriculture

Prevalence of Gypsy Moth in 1953

Populations of the Gypsy moth, *Porthetria dispar* (L.), had declined to extremely low levels by the summer of 1950 in the infested areas of the north-eastern states and defoliation of forest growth by this insect during that year covered only 5,400 acres. In succeeding years mild winters in that area and other conditions were favorable for rapid increase in populations. As a result of these unusual conditions, forest growth on more than 1,487,000 acres was defoliated by Gypsy moths in the summer of 1953. The previous high peak in population abundance occurred in 1945 when trees on nearly 821,500 acres were defoliated throughout the infested area. As would be expected, there was far greater mortality of trees in 1953 than in any year since the Gypsy moth first became established in the United States.

Yugoslavia

Federal Plant Protection Service, Belgrade

Status of Gypsy Moth in 1953

Heavy infestation by Gypsy moth (*Porthetria dispar* L.), was observed in 1953 in various parts of the country and particularly in Serbia, where 15 districts were reported to be under severe attack. The heaviest attacks occurred in an eastern district bordering on Rumania and in an area close to the Albanian frontier. A number of districts in Slovenia, Croatia and Macedonia were also infested, but these outbreaks were far less extensive and less intense.

In Serbia, the worst damage occurred in woodlands, but fruit trees were also attacked. In three districts the forests were totally defoliated. It is estimated that in Serbia alone 25,000 hectares of forests and 1,200 hectares of orchards are infested.

Gypsy moth infestation periodically reaches epidemic proportions in Yugoslavia and the damage caused is extremely heavy.

The last of these peak periods lasted from 1947 to 1950 and losses during these three years were estimated at over 6½ million pounds sterling.

Effective control could be accomplished only by destruction of the eggs in the woodlands, but in many parts of the country access to the infested areas is still difficult or even impossible and progress is necessarily slow.

Spread of Plum Pox disease

Plum pox caused by peach mosaic virus (*Marmor persicae* Holmes = *Annulus pruni* Christoff) and locally known as sarka disease, has now spread over the entire country, except Slovenia. The worst attacks are reported in Serbia, where the disease exists practically in every orchard. It is estimated that throughout Yugoslavia over 16 million plum trees will yield no fruit. The best variety of Yugoslav plum, Požegača, which is in great demand on foreign markets, is in danger of complete destruction.

This disease has been known in Bulgaria since 1932 and in Yugoslavia since 1937. It probably also occurs as far north as Bohemia and Holland and a single tree apparently affected by it was discovered in Hampshire, England, in 1943. The common signs of infection are mottled leaves and fruits, which may also show malformation. The disease causes fruit drop before ripening and consequently very little fruit remains on the infected trees.

The disease has been transmitted experimentally by grafting and by the aphid *Anuraphis padi*, but the latter is apparently of little practical importance.

Although various methods for controlling this disease have been suggested, including the certification of nursery stocks and the use of resistant varieties, it has proved impossible so far to deal effectively with the disease in the field for technical and financial reasons.

(The above information was received from the European Plant Protection Organisation, Paris.)

NEWS AND NOTES

International Commission on Plant Disease Losses

The International Commission on Plant Disease Losses was organized in 1951 within the framework of the International Union of Biological Sciences, under the chairmanship of Dr. K. Starr Chester, of the Battelle Memorial Institute, Columbus, Ohio. The announced program of the Commission includes:

1. serving as a clearing-house for information on plant/disease/loss data;
2. catalyzing the study of plant disease losses, and
3. furnishing authoritative information on plant disease losses to agencies and individuals having need of such information.

The Commission plans to convene its first meeting in Paris in connection with the Eighth International Congress of Botany, 2-14 July 1954. Among the subjects to be discussed will be a plan for the preparation of a comprehensive handbook on loss appraisal methods.

Mediterranean Fruit Fly Meeting

A meeting was convened in Algiers, 26-29 January 1954, by the European Plant Protection Organisation to consider various aspects of the Mediterranean fruit fly, *Ceratitis capitata*. It was attended by 17 delegates representing 11 countries and FAO. Discussions were divided under two main subjects:

1. the biology of the insect and its relation to control operations in the orchard and in harvested fruit destined for export, and
2. the need for proper phytosanitary certificates to accompany exports and the simplification and standardization of them.

After considerable technical discussions on the ecology of the insect and the efficiency of present control operations, the Meeting agreed on the co-ordination of future investigations and on certain principles concerning phytosanitary regulations. Details of the discussions and the agreements reached will soon appear in the report to be issued by the European Plant Protection Organisation.

World Bibliography of Plant Protection

In 1921 the former Biologische Reichsanstalt für Land-und Forstwirtschaft in Berlin/Dahlem launched an invaluable project in issuing a series of Bibliographie der Pflanzenschutzliteratur to enable scientists working in the field of plant protection to learn about the voluminous literature published in various countries. The first volume included the phytopathological and entomological literature of the world for the period from 1914 to 1919. By 1944 twenty more volumes had appeared, containing a collection of literature through 1939.

After an interruption of almost ten years, the Biologische Zentralanstalt für Land-und Forstwirtschaft in Berlin/Dahlem has resumed this massive task and a new volume of this series covering the period from 1940 to 1945 was published at the end of 1953. This volume comprises two parts and 1,308 pages. The literature is classified into many sections according to the subjects under four main headings, which deal with general plant protection, causal agents, diseases and pests of individual plant groups, and plant protection measures.

The next volume to follow shortly will cover the period from 1946 to 1951, and subsequent volumes will appear at regular intervals.

This publication is available for exchange from the Bibliothek der Biologischen Zentralanstalt für Land-und Forstwirtschaft, Berlin/Dahlem, Königin-Luise-Strasse 19, Germany.

Roma - Tip. del Senato del dott. Giovanni Bardi

CEREAL BREEDING PROCEDURES

This FAO Development Paper covers the whole field from the hybridization of the parent plants until a new variety is in commercial production. Methods of growing hybrid populations, systems of testing and recording of results, variety purification and increase of pure seed, as well as the analysis of data, are treated in detail. Various types of nurseries are described for the breeding of varieties resistant to plant diseases and insect pests, and tolerant to certain climatic factors such as frost.

Special features of the publication are the sixteen appendices which graphically illustrate planting plans, plot arrangements, the statistical progress of a cross, variety purification and other features of a cereal breeding program. The complexity involved in modern plant breeding methods and the consequent necessity of systematizing the procedures are clearly and impressively indicated, 122 pages, $ 1.25; 6s. 6d.

LEGUMES IN AGRICULTURE

This unique collection of information on legumes, edited by R. O. Whyte, G. Nilsson-Leissner and H. C. Trumble, required the collaboration of specialists in every member country of FAO. No fewer than 111 contributors are acknowledged, and contributions from many more are mentioned in the text.

Nowhere else is such information available in one volume and, by pointing to the limitations in the data on economic botany, ecology and the biotic relationships of legumes it is hoped to encourage further research and experiment particularly in tropical and sub-tropical areas. An appendix tabulates the species, indicating plant characteristics, climatic adaptation, soil adaptation, utilization, number of seeds per pound and seeding rates in pounds per acre. 368 pp., many illustrations, $ 3.00; 15s.

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